Filter Element

The invention relates to a filter element, especially for use in backflush filter devices, with a filtration part through which a fluid which has contaminants can flow at least in one direction, there being a capture device which has at least one rod-like permanent magnet or electromagnet, which removes magnetizable, especially ferritic portions, at least partially from the fluid before it flows through the filtration part, there being a stripping means for removal of the indicated portions from the capture device.

EP-0 968 039 B1 discloses a backflush filter device for use of slotted hole screen tubular filter elements which can be accommodated in a housing with a filter inlet and an outlet for the fluid to be filtered, flow through the filter elements for filtration or backflushing being possible in both directions, and for backflushing there being a drivable flushing arm which has a fluid outlet for fouled fluid and which can be moved in succession under the flow cross sections of the filter elements. In the known solution at least some of the inserted slotted hole screen tubular filter elements which are used are made conical, the structural length of the conical filter elements being at least ten times greater than the largest existing passage cross section for the fluid, the distance between the individual conical slotted hole screen tubular filter elements or between them and the cylindrical ones in the direction of their free ends is enlarged with the result that the outflow space in the filter housing is enlarged and moreover the escape resistance in filter operation is lowered. During backflushing the conical slotted hole screen tube filter element presents a clear advantage

over the cylindrical one, primarily the relatively larger exit cross section of the conical filter elements compared to the cylindrical ones for the same filter surface being the cause of this. But since the exit cross section for the conical filter elements is comparatively small relative to the entry cross section formed by the filter surface, that is, the free element surface, depending on the magnitude of the flow resistance of the slotted tube, a bottleneck forms in which a large part of the system pressure drops off. Therefore, in the known solution small pressure losses occur; this has a beneficial effect in terms of energy during backflushing.

During backflushing a large part of the volumetric throughput for conical and cylindrical filter elements is achieved fundamentally on the lower filter end and the volumetric flows decrease very quickly. Since the conical element is backflushed much farther, in addition the velocity gradient is less, so that with incorporation of the velocity profiles relative to the filter surface there is an additional cleaning effect compared to cylindrical elements due to the conicity of the element. This takes place carefully due to the essentially constant velocity attained when the conical filter elements are being cleaned off; this prolongs the service life of these filter elements.

DE 40 30 084 A1 discloses a backflushing device which can be backflushed with the dirty liquid which is to be filtered, preferably in counterflow to the filtering direction. The known solution in the filter housing has a plurality of filter cells in a circular configuration which can be connected to the sludge discharge using a flushing arm which is driven by a rotary drive individually or in small groups for backflushing. Although in the known configuration in the backflushing process the dirty liquid flows through the filter cells with a high turbulent velocity in the longitudinal direction and in the process dissolves and removes the deposited contaminants, the filtering and backflushing result can be improved. Since the filter elements are made cylindrical, they are located tightly next to one another in the filter housing and the free discharge space in the filter housing is accordingly small, so that in normal filter operation the outflow resistance for the filtered fluid is increased by the mutual influence of the cylindrical filter

elements on one another, and accordingly the pressure difference between the filter inlet and outlet is also increased. But this leads to an altogether poor energy balance in the described known solution.

Even if, as described in DE 83 06 970 U, the cylindrical filter elements are located at a clear distance from one another within the filter housing, especially during backflushing of these cylindrical filter elements a nonuniform fluid flow results with the consequence that the fluid speed continuously increases within the cylindrical elements; this likewise adversely affects the energy balance of the entire backflushing device.

DE 38 12 876 A1 discloses a conical filter element which is used for filtering and separating different substances and particles, a conically wound wire in the form of a helix or a helical cone being routed within support rods which run onto one another. The penetrated conical construction in which the length-width ratio is in the range of 1 produces a type of funnel effect which is intended to enhance the separation performance. Even if the pertinent conical filtering and separating element were used in a backflushing device, in any case a larger exit cross section for the fluid relative to the entry cross section formed by the filter surface would not be achieved and thus increased flow resistances arise which adversely affect the efficiency during backflushing. A device comparable to this is also disclosed by US-A-2,237,964.

When the conical or cylindrical filter elements according to the above described prior art and the pertinent backflushing devices are used for filtration tasks, in which ferritic portions can be found as contaminants in the fluid flow to a high degree, which is for example often the case in cooling lubricant fluids which are to be filtered, the described known solutions however reach their performance limits. They do filter the ferritic portions out of the fluid flow; the free filter pores of the respective filtration material used however quickly clog with the ferritic portions so that soon the filtration part of the respective filter element is blocked, regardless of whether it is

made conical or cylindrical. Even if these filter elements are then used in backflushing filter devices in which there is the possibility of counterflushing the respective filter element in the opposite throughflow direction from the clean side to clean off the filtration part, on the one hand the pertinent cleaning processes must then be undertaken exceptionally often; this adversely affects the filtration performance of the respective device. On the other hand, agglutination or caking of the ferritic portions with the filter material of the filtration part often occurs so that in this respect during backflushing the ferritic contamination may also remain joined to other contaminant portions in the filtration part or damage to the filtration part occurs during backflushing, especially on its filtration layer or the slotted hole screen tube material of the filter element.

FR-2 718 065 A1 discloses a generic filter element which removes contaminants from the fluid as throughflow proceeds from the inside to the outside. In the filter element with its cylindrical mat structure, there are two rod-shaped permanent magnets which trap magnetizable, especially ferritic portions, out of the fluid as it flows through the filter element. In order to remove the captured ferritic portions from the rod-like permanent magnets, as the stripping means there is a stripping plate which encloses the rod-like permanent magnets on the outer circumferential side and which is configured to be able to move within the filter element space by means of a hydraulic or pneumatic cylinder, and effects clean-off in the direction of motion from top to bottom in the position of use of the filter element, the discharge of the ferritic portions taking place on the bottom of the filtration part which is held in the housing. After clean-off in the form of stripping, the working cylinder resets the stripping plate back into its initial or rest position above the actual filter element so that the known solution, especially due to use of the working cylinder, is designed to not only be geometrically large in the axial direction, but also requires additional energy for cleaning or stripping during operation of the respective working cylinder.

On the basis of this prior art the object of the invention is to further improve known filter element designs, especially also those intended for use in backflushing filter devices, such that when magnetizable, especially ferritic portions occur in the fluid flow which is to be filtered, the described disadvantages, especially devices with a not overly large structure which require additional energy for stripping operation, do not arise. This object is achieved by a filter element with the features specified in claim 1 in its entirety.

In that, as specified in the characterizing part of claim 1, the stripping means is formed from a stripping ring which as it moves along the rod-shaped magnet removes the portions which are held by the capture device and when the filtration part is being backflushed the stripping ring moved by the fluid flow effects stripping of the portions which have been fixed on the capture device, it is ensured that the magnetizable, especially ferritic portion component of the contaminants which are to be filtered out of the fluid, which component adversely affects the filtration performance and the filter element material, cannot reach the filtration part with its selective filter material at all, but is separated beforehand in significant parts from the fluid flow. This separation takes place by capturing the magnetizable, especially ferritic portions, in a very effective manner even if these portions comprise a large part of the contaminants in the fluid which is to be filtered. Furthermore, the selectivity of the filtration part with its filter material can be oriented to the contaminants which are to be conventionally expected, so that no special, especially costly adaptations are necessary here, but rather the filtration part can be selected within the framework of what is conventional, and by way of the capture device it is ensured that the selective material does not come into contact at all with the magnetizable contamination portions to any significant extent. Accordingly the filter element design as claimed in the invention can also be implemented especially cost-effectively and thus economically.

The stripping means as claimed in the invention is formed from a stripping ring which, as it moves along the rod-like magnet, effects removal of the fluid portions which have been

The filter element as claimed in the invention is detailed below using one embodiment as shown in the drawings. The figures are schematic and not to scale.

FIG. 1a shows in a partial cutaway a side view of the filter element in the form of a slotted hole screen tubular filter element without the magnet capture device;

FIG. 1b shows a section along line I-I in FIG. 1a;

FIG. 1c shows in an enlarged representation a detail designated as "X" in FIG. 1a;

FIG. 2 shows a longitudinal section through a backflush filter device with cylindrical and tapering filter elements;

FIG. 3 shows, viewed partially in a front view, partially in a longitudinal section, a side view with the internal structure of the filter element as shown in FIG. 1a, in FIG. 3 the filter material being shown only schematically and not in detail.

The slotted hole screen tubular filter element 8 shown in FIG. 1 in a side view in the direction of its longitudinal axis 10 has support rods 12 tilted toward it, around which a wire profile 16 is wound in individual turns 18, leaving gaps 14 through which the fluid can pass, in the area of each contact point of the wire profile 16 with the support rod 12 there being a weld. The gap size which is provided for free fluid passage, therefore the distance between two gaps 14, is shown in FIG. 1c with arrows 20 which face one another.

As furthermore shown especially by FIG. 1a, the respective support rod 12 with its one end 22 is tilted toward the longitudinal axis 10 such that an overall tapering filter element 8 is formed, the turns 18 of the wire profile 16 decreasing in diameter in the direction of the tilted ends

22 of the support rods 12; this is also apparent from FIG. 1b. Instead of a single wire profile 16, as shown in the figures, optionally several successive wire profiles or wire profiles wound and located on top of one another (not shown) can also be used, if this is necessary for the indicated filtration task. The length L of the slotted hole screen tubular filter element 8 measured in the direction of the longitudinal axis 10 is approximately 11 times greater than the greatest existing passage cross section D for the fluid on the end of the filter element 8 which is the right end viewed in the direction of looking at FIG. 1a.

The support rods 12 and the wire profile 16 consist of high-grade steel, the support rods 12 being square in cross section and the wire profile 16 being triangular. The gap widths which are to be selected and which are identified with the double arrow 20 in FIG. 1c can be matched to the size of the solid portions to be filtered out of the fluid, especially in the form of hydraulic oil, the filtered fluid passing freely through the gaps 14 and the solid portions or dirt portions which have been filtered out and retained by the turns 18 of the wire profile 16 remaining within the filter element 8 or settling partially in the gaps 14, with the result that as the slotted hole screen tubular filter element 8 is used for a longer and longer time, it becomes increasingly clogged and can no longer be used for filtration. In the pertinent case, in the reversed fluid passage direction the filter element 8 can be cleaned out by backflushing. In FIG. 1a in a schematic the direction of filtration from the inside to the outside is identified with an arrow 24 and the opposite direction of backflushing is designated with an arrow 26. For the sake of simpler representation the magnet capture device as claimed in the invention is not shown in FIGS. 1a, b, c.

The operation and use of the above described slotted hole screen tubular filter element using a backflushing filter device as shown in FIG. 2 are explained below.

The backflushing filter device shown in FIG. 2 has a cylindrical housing 30 with sealing covers 32, 34 which can be fixed on the filter housing 30 by way of flange connections 36. The

housing 10 of the backflushing device has a filter inlet 38 for the fluid which is to be filtered and a filter outlet 40 for the filtered fluid. The fluid direction in filtering operation through the housing 30 is indicated in FIG. 2 with the corresponding arrow at the filter inlet 38 and filter outlet 40. In addition to the conical filter elements 8 which are located on the left when viewed in the direction of looking at FIG. 2, cylindrical filter elements 42 are also used. Both the conical slotted hole screen tubular filter element 8 and also the cylindrical slotted hole screen tubular filter element 42, divided into groups at distances from one another, are configured in a plurality along cylindrical arcs within the filter housing 30. All the filter elements shown in FIG. 2 discharge with their inlet cross section D, that is to say, with their free opening, into cylindrical recesses 44 of the lower sealing cover 34. On its opposite end which is the respective other end, the conical and cylindrical filter elements 8 and 42 which are being used are provided with sealing caps 46 with which each end of a wire profile 16 is welded and by way of which the filter elements are held on a plate-shaped intermediate piece 48 against which the upper sealing cover 32 abuts from the top.

For the actual backflushing of the backflushing filter device there is a drivable flushing arm 50 which on its bottom provides a connection in the form of a fluid outlet 52 for fouled fluid. The flushing arm 50 which has two different arm segments 54 in its length can be moved by way of a drive rod 56 in succession to under the passage cross sections D of the conical and cylindrical filter elements 8 and 42. Therefore backflushing takes place continuously with the actual filtration process, only the filter elements 8, 42 being backflushed, from the outside to the inside, with the cleaned, filtered fluid which is formed during filtration with the other filter elements, with the arm sections 54 of the flushing arm 50 extending under their free passage cross sections D. To drive the drive rod 56, especially in the form of a hollow shaft, on the top sealing cover 32 there is a spline shaft connection 60 by way of which the drive rod can be driven with the motor or the like for rotational revolution around the longitudinal axis 56.

for example with a conventional filter mat structure, can be kept free of ferritic portions in the selective material in this way.